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In situ supported VO_x on carbon nanotubes for the low-temperature selective catalytic reduction of NO with NH_3

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Selective catalytic reduction (SCR) of NO_x with NH_3 is nowadays considered as the most promising technology for the elimination of NO_x [1]. As a typical commercial NH_3-SCR catalyst, V_2O_5-WO_3(MoO_3)/TiO_2 catalysts are commonly used due to the high catalytic activity and SO_2 tolerance [2]. However, there are some unavoidable disadvantages in commercial V-Ti catalysts. For example, the active component is unevenly dispersed and easily detached from the surface of the carrier under the scouring of the flue gas, thus shortening the service life of the catalyst. In addition, the operating temperature of the V-Ti catalyst is relatively high, about 300-400 ºC, and its catalytic activity is poor at low temperature. Therefore, it is extremely urgent to develop a SCR catalyst with high low temperature activity and good stability.

In order to solve the above problems, vanadium oxide was supported on the surface of the carbon nanotube by in-situ growth because the introduction of carbon nanotubes can improve the low temperature catalytic activity of the catalyst. And the in situ synthesis method can enhance the interaction between VO_x and the carrier, thus enhancing the dispersion of VO_x. In our work, the VO_x were in situ supported on carbon nanotubes (CNTs) by a Cetylpyridinium Chloride (CPC) assisted reflux route. It was found that the in situ prepared catalyst exhibited better NH_3-SCR activity at low temperature, better stability, higher SO_2-tolerance and improved water-resistance than that of the catalysts prepared by impregnation or a mechanically mixed method. The EDS-mapping results indicated that the vanadium oxide species had good dispersion on the CNTs surface. The XPS results demonstrated that there were lower valence vanadium species (V^{4+} and V^{3+}) and chemisorbed oxygen species. According to the literatures, vanadium oxides with low valence states can easily adsorb oxygen to generate active oxygen species during SCR reaction, which is important to the low temperature SCR activity [3]. The H_2-TPR results suggested that there was a strong interaction tetween the vanadium oxide on the surface of CNTs. The NH_3-TPD results demonstrated that the catalysts presented a larger acid amount and stronger acid strength. The in situ prepared VO_x/CNTs catalyst could be considered as a promising candidate for the low-temperature SCR of NO with NH_3.

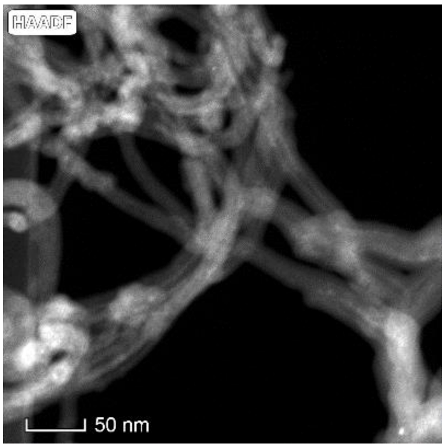

Figure 1. EDS-mapping of V_2O_5/CNTs catalyst.

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